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The lichen genus *Lepraria* (*Stereocaulaceae*) in South Korea

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Abstract — The species belonging to lichen genus *Lepraria* that occur in South Korea are revised. Seventeen taxa are accepted. Brief descriptions of the species and a key to the taxa are provided. All species described here except *L. coriensis* are new to South Korea. Among them, *L. caesiella, L. eburnea, L. leprolomopsis, L. lobata, L. pallida, L. texta* and *L. xerophila* are reported for first time from eastern Asia (including China and Japan).

Key words — geographical distribution, lichen-forming fungi, taxonomy

Introduction

As the name indicates, *Lepraria* Ach. (Latin *leprosus* = a scurfy sorediate appearance) is characterized by leprose thallus with an entirely sorediate surface (Laundon 1992, Tønsberg 1992) that is sometimes squamulose or with isidia like structures (Crespo et al. 2006, Tønsberg 2004, Wirth et al. 2004). The chemistry of this genus includes depsides, depsidones, usnic acids, benzyl esters, dibenzofurans, fatty acids, anthraquinones, terpenoids, and aliphatic acids.

Lepraria is a widely distributed genus that comprises ca. 61 species (Elix & Kalb 2008, Kukwa & Flakus 2009, Saag et al. 2009). It occurs in alpine, temperate, and tropical regions on soil, rock, mosses, wood, bark, and other lichens. Recent molecular studies by Ekman & Tønsberg (2002) have confirmed that it belongs to *Stereocaulaceae*.

Saag et al. (2009) have surveyed the genus on a worldwide basis. However, the East Asian species have not been critically revised. Wei (1991) reported 2 species of *Lepraria* from China [*L. incana* (L.) Ach. and *L. yunnaniana* (Hue) Zahlbr.], while Harada et al. (2004) reported 5 species from Japan [*L. cacuminum* (A. Massal.) Loht., *L. cupressicola* (Hue) J.R. Laundon, *L. lobificans*, *L. membranacea*, *L. vouauxii*]. However, only one species, *L. coriensis* (≡ *Crocynia coriensis* Hue), has been reported from South Korea (Hue 1924, Hur

et al. 2005, Kim 1981, Sato 1943). Moon (1999) reported *Lepraria* from South Korea but excluded it from her studies because of taxonomic complexities in this genus.

Herbarium study at Korean Lichen Research Institute (KoLRI) and recent collection of leprarioid lichens from different places in South Korea revealed the occurrence of 17 *Lepraria* species within this country. Except *L. coriensis*, all the species are new to South Korea. Seven taxa (*L. caesiella*, *L. eburnea*, *L. leprolomopsis*, *L. lobata*, *L. pallida*, *L. texta, L. xerophila*) are new to East Asia.

The present paper covers the leprarioid lichens reported from South Korea for the first time as well as species earlier reported from this part of the continent and expands the knowledge of lichen diversity in East Asia including China and Japan. A brief taxonomic description and comments are provided for each species along with a key to all the leprarioid lichens of South Korea.

Materials and methods

The study is based on lichen specimens lodged in the herbarium of Lichen & Allied Bioresource Center, Korean Lichen Research Institute (KoLRI), Sunchon National University, South Korea, as well as fresh samples collected during recent field trips. A total of thirty-five specimens have been examined under NIKON C-PS 1068908 dissecting microscope and studied with Thin Layer Chromatography (TLC) using solvents A and C, following the standardized methods of Culberson (1972), Elix et al. (1987), and White & James (1985).

Taxonomy

Key to the species of *Lepraria* in South Korea

(adapted from Saag et al. 2009 with some amendments)

1. Granules or lobules similar to isidia present, soredia few or absent ..... *L. xerophila*
1. Granules or lobules similar to isidia absent, soredia numerous 2
2. Stictic acid complex present 3
2. Stictic acid complex absent 5
3. Terpenoids present 4
3. Terpenoids absent ..... *L. caesioalba* var. *caesioalba*
4. Thallus greenish; soredia fine to medium sized (20–60 µm diam.) and with long projecting hyphae; zeorin present ..... *L. lobificans*
4. Thallus yellowish; soredia medium sized to coarse (75–110 µm diam.) and with or without short projecting hyphae; zeorin absent ..... *L. leprolomopsis*
5. Alectorialic acid present 6
5. Alectorialic acid absent 7
6. Thallus soft, soredia loosely packed, medulla distinct and thick ..... *L. eburnea*
6. Thallus hard, soredia densely packed, medulla inconspicuous ..... *L. neglecta*

7. Pannaric acid or one of pannaric acid derivatives present as main substance 8
7. Pannaric acid and its derivatives absent or in traces besides other major dibenzofurans 10
8. Lobes absent or poorly developed 9
8. Lobes present ..... *L. membranacea*
9. Thallus with less or no patches of exposed medulla; 4-oxypannaric acid 2-methylester as major dibenzofuran .....*L. diffusa*
9. Thallus with exposed patches of medulla between soredia; pannaric acid 6-methylester as major dibenzofuran .....*L. vouauxii*
10. Usnic acid present together with zeorin 11
10. Usnic acid absent, zeorin present or absent.....13
11. Distinct well developed marginal lobes present, over 0.5 mm wide and with marginal rim..... *L. coriensis*
11. Marginal lobes absent or obscure, less than 0.5 mm wide and without marginal rim.....12
12. Obscure lobes present; medulla present, thick; soredia fine to coarse (up to 450 μm in diam.).....*L. leuckertiana*
12. Obscure lobes absent; medulla absent or thin; soredia fine (up to 50 μm in diam.)..... *L. texta*
13. Norascomatic acid present..... *L. xerophila*
13. Norascomatic acid absent 14
14. Distinct well-developed marginal lobes present, over 0.5 mm wide and with marginal rim 15
14. Marginal lobes absent or obscure.....16
15. Hypothallus present, gray to black; unidentified fatty acids present ..... *L. pallida*
15. Hypothallus absent (medulla present); rangiformic/jackinic acid present.. *L. lobata*
16. Zeorin present, fatty acids present or absent.....17
16. Zeorin absent, roccellic/angardianic acid present ..... *L. celata*
17. Fatty acids absent; medulla and/or hypothallus absent ..... *L. caesiella*
17. Fatty acids present; medulla and/or hypothallus present 18
18. Thallus hard, soredia densely packed, consoredia up to 300 μm diam ..... *L. lobata*
18. Thallus soft, soredia loosely packed, consoredia up to 160 μm diam..... *L. jackii*

1. ***Lepraria caesiella*** R.C. Harris, Opuscula Philolichenum 2: 51, 2005

Diagnostic characters — Thallus leprose, powdery, pale bluish gray, margin diffuse, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes forming ±rounded colonies. Lobes absent. Soredia abundant, dispersed or forming a thick continuous layer, very fine, 20–30 μm in diam., commonly aggregated in ±round consoredia up to 100 μm diam.,

projecting hyphae present. Medulla absent. Hypothallus absent. For further descriptions see Lendemer (2005).

Chemistry — Spot test reactions: thallus K+ faint yellow to yellow-orange, C–, KC–, P–. Secondary metabolites: Atranorin and Zeorin.

Besides atranorin and zeorin, Saag et al. (2007) also reported roccellic/angardianic acid or an unidentified fatty acid from some specimens of *L. caesiella*.

Ecology — The species was found growing over *Pinus* bark at an elevation of 431 m.

Geographical distribution — North and South America, Greenland (Saag et al. 2009); new to East Asia (South Korea).

Specimen Examined – South Korea: Gyongsangbuk Prov.: Mt. Kongduck, N36°44'42.5", E128°15'54.2", alt. 431 m, on *Pinus* bark, 20 June 2007, Hur 070772 (KoLRI).

Remarks — *Lepraria jackii*, *L. lobata,* and *L. pallida* are the other atranorin and zeorin containing South Korean *Lepraria* species with which *L. caesiella* is most likely to be confused. *L. jackii* differs in having jackinic/rangiformic acid and a white hypothallus. *L. lobata* differs in having lobes and roccellic/angardianic acid, while *L. pallida* differs in having lobes and tomentose, gray to black hypothallus.

2. *Lepraria caesioalba* (B. de Lesd.) J.R. Laundon, Lichenologist 24: 324, 1992, **var. *caesioalba***

Diagnostic characters — Thallus leprose, powdery, whitish gray to bluish gray to yellowish gray to grayish green, forming ±regular rosettes which later sometimes coalesce and form irregular patches. Margin delimited or not. True lobes absent, but obscure minute lobes sometimes present without raised rims. Soredia abundant, usually compact, coarse, 150–180(–200) µm in diam., commonly aggregated in ±round consoredia up to 200–300 µm diam., projecting hyphae sometimes present, short. Medulla present, inconspicuous, white. Hypothallus absent. For further descriptions see Laundon (1992), Lohtander (1994) and Saag et al. (2007).

Chemistry — Spot test reactions: thallus K+ yellow, C–, KC–, P+ yellow. Secondary metabolites: Atranorin, Stictic acid complex and Zeorin (Chemotype 2). It is the most common Chemotype of this species in South Korea.

Two other chemotypes besides Chemotype 2 have been reported for this species: Chemotype 1, which is regarded as the most frequent (at least in Europe), contains atranorin, fumarprotocetraric acid, protocetraric acid and ±roccellic/angardianic or rangiformic acid, while Chemotype 3, the rarest chemotype, contains atranorin, psoromic acid and roccellic/angardianic or rangiformic acid (Leuckert et al. 1995).

Ecology — *Lepraria caesioalba,* one of the most common *Lepraria* species in South Korea, has been found growing over bark, soil, and non-calcareous rocks between elevations of 70–1104 m.

Geographical distribution — Europe, North and South America, Asia, Australasia, Antarctica, Greenland (Saag et al. 2009); new to South Korea.

Specimens Examined – South Korea: Jeollanam Prov.: Sunchon, Sunchon National University, N34°57'59.3", E127°28'44.8", alt. 70 m, on *Pinus densiflora*, 05 October 2005, L. Lőkös 050628 (KoLRI); Kangwon Prov.: Galjeongo bong, N37°52'952", E128°30'161", alt. 1104 m, on rock, 22 May 2009, Y. Joshi & X. Y. Wang 090589 (KoLRI); Kangwon Prov.: Mt. Seorak, N38°09'981", E128°27'267", alt. 463 m, on soil over rock, 24 May 2009, Y. Joshi & X. Y. Wang 090756, 090794 (KoLRI); Kangwon Prov.: Hangae ryong, N38°05'433", E128°25'131", alt. 750 m, 25 May 2009, on dead trunk, Y. Joshi & X. Y. Wang 090902 (KoLRI).

Remarks — *Lepraria leprolomopsis* and *L. lobificans,* which are the other stictic acid complex containing South Korean species with which *L. caesioalba* var. *caesioalba* can be confused, differ in having a well developed conspicuous medulla. *Lepraria nivalis* J.R. Laundon and *L. santosii* Argüello & A. Crespo are the other atranorin and stictic acid complex containing species with which *L. caesioalba* var. *caesioalba* is often confused. *L. nivalis* differs in having a well developed medulla, while *L. santosii* differs in having distinctly lobate thallus with thick raised marginal rims.

3. *Lepraria celata* Slav.-Bay., Lichenologist 38: 504, 2006

Diagnostic characters — Thallus leprose, powdery, bluish gray, margin diffuse or delimited, forming thin to thick ±continuous extensive irregularly spreading patches. Lobes absent. Soredia abundant, forming a thick continuous layer, very fine, 20–30 µm in diam., projecting hyphae absent. Medulla absent. Hypothallus sparsely present as white patches. For further descriptions see Slavíková-Bayerová & Orange (2006).

Chemistry — Spot test reactions: thallus K–, C–, KC–, P–. Secondary metabolites: Atranorin and a fatty acid (roccellic/angardianic acid).

Ecology — The species is found growing over non-calcareous rocks at an altitude of 1192 m.

Geographical distribution — Europe (Saag et al. 2009); new to Asia (South Korea).

Specimen Examined – South Korea: Kangwon Prov.: Dongpalam valley, N37°51'359", E128°30'974", alt. 1192 m, on rock, 23 May 2009, Y. Joshi & X. Y. Wang 090670-1 (KoLRI).

Remarks — *Lepraria lobata* and *L. neglecta* are other roccellic/angardianic fatty acid containing South Korean species with which *L. celata* may be confused. *Lepraria lobata* differs in having zeorin, distinct lobes, a medulla, and

no hypothallus, while *L. neglecta* has alectorialic acid as a major compound, obscure minute lobes, and an inconspicuous medulla.

4. *Lepraria coriensis* (Hue) Sipman, Herzogia 17: 28, 2004

Diagnostic characters — Thallus leprose, powdery to membranous, greenish gray, often forming irregular rosettes which later sometimes coalesce and form non-areolate appressed crust of powdery granules. Margin delimited. Lobes present, obscure or more often well developed (0.5–1.5 mm wide) with raised marginal rim. Soredia sparse to abundant, exposing smooth ecorticate surface, fine to coarse, 70–100(–250) µm in diam., commonly aggregated in ±round consoredia up to 200–350 µm diam., projecting hyphae absent. Medulla usually present, white. Hypothallus sometimes present, brown to black. For further descriptions see Laundon (2003), Sipman (2004) and Elix (2009).

Chemistry — Spot test reactions: thallus K–, C–, KC–, P–. Secondary metabolites: Usnic acid, Zeorin, Constipatic acid (Chemotype 1). It is the commonest chemotype met within this species.

Besides Chemotype 1, two other chemotypes have been reported for this species: Chemotype 2 (usnic acid, zeorin, protodehydroconstipatic and constipatic acids, isousnic acid, argopsin, norargopsin, atranorin) and Chemotype 3 (usnic acid, zeorin, protodehydroconstipatic and constipatic acids, caloploicin, fulgidin, isousnic acid, atranorin) (Elix 2006b).

Ecology — At the collection site (425 m), the species was found growing over non-calcareous rocks.

Geographical distribution — Asia (India, Hong Kong, Taiwan, South Korea) and Australia (Saag et al. 2009, Elix 2009).

Specimen Examined – South Korea: Chungchongbuk Prov.: Mt. Songni, N36°32'34.7", E127°51'15.0", alt. 425 m, on rocks, 21 April 2006, Hur 0600023 (KoLRI).

Remarks — The presence of distinctly lobed thallus margins with raised rims and constipatic acid separate *L. coriensis* from the two other usnic acid containing South Korean species, *L. leuckertiana* and *L. texta*. The other two species both have a diffused thallus margin or rimless lobes and lack constipatic acid.

5. *Lepraria diffusa* (J.R. Laundon) Kukwa, Ann. Bot. Fennici 39: 226, 2002

Diagnostic characters — Thallus leprose, powdery to cottony, grayish cream to yellowish green, diffuse, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes forming ±rounded colonies. Margin diffuse or rarely delimited. Lobes absent. Soredia abundant, usually compact, coarse, up to 100 µm in diam., projecting hyphae sometimes present, short. Medulla present, white. Hypothallus sometimes present, whitish gray to

brownish. For further descriptions see Laundon (1992) and Kukwa (2006).

Chemistry — Spot test reactions: thallus K+ pale yellow, C–, KC–, P–. Secondary metabolites: 4-oxypannaric acid 2-methylester.

Ecology — At the collection site (706 m), the species was found growing over non-calcareous rocks.

Geographical distribution — Asia, Europe and North America (Saag et al. 2009); new to South Korea.

Specimen Examined – South Korea: Kangwon Prov.: Dongpalam valley, N37°51'692", E128°31'522", alt. 706 m, on rock, 23 May 2009, Y. Joshi & X. Y. Wang 090730-1 (KoLRI).

Remarks — *Lepraria diffusa,* which has 4-oxypannaric acid 2-methylester as the only major dibenzofuran, might be confused with two other dibenzofuran-producing South Korean species, *L. membranacea* and *L. vouauxii*. *Lepraria membranacea,* however, has pannaric acid as the major dibenzofuran, while *L. vouauxii* has pannaric acid 6-methylester as a major secondary compound.

6. *Lepraria eburnea* J.R. Laundon, Lichenologist 24: 331, 1992

Diagnostic characters — Thallus leprose, powdery to cottony, white to whitish gray to bluish gray, greenish gray or yellowish gray, shape irregular. Margin diffuse to rarely delimited. Lobes usually absent, but sometimes with indistinct lobes. Soredia abundant or sparse, exposing smooth ecorticate surface, fine, 45–60 μm in diam., commonly aggregated in ±round consoredia up to 200–400 μm diam., projecting hyphae present, long. Medulla present, thick, white. Hypothallus not distinct. For further descriptions see Orange (1997) and Elix (2009).

Chemistry — Spot test reactions: thallus K– or + yellow, C– or + reddish orange, KC+ reddish orange, P+ yellow or orange. Secondary metabolite: Alectorialic acid (Chemotype 3).

Besides Chemotype 3, two other chemotypes have been reported for this species: Chemotype 1, the most frequently encountered, contains alectorialic acid and protocetraric acid, while Chemotype 2 has alectorialic acid, psoromic acid and 2'-*O*-demethylpsoromic acid (Orange 1997).

Ecology — *Lepraria eburnea,* one of the most common *Lepraria* species in South Korea, has been found growing over bark of *Pinus densiflora* and on soil over rocks between elevations of 115–673 m.

Geographical distribution — Europe, North America, Australasia and Greenland (Saag et al. 2009); new to East Asia (South Korea).

Specimens Examined – South Korea: Jeollanam Prov., Boseong Co., Mt. Illim, N34°41'17.7", E127°00'57.3", alt. 220 m, on bark, 01 September 2005, Hur 050370 (KoLRI); Hwasun Co., Mt. Baega, N35°10'32.4", E127°08'23.", alt. 320 m, on *Pinus*

densiflora bark, 08 October 2005, L. Lökös 050654 (KoLRI); Sunchon, Sunchon National University, N34°58'00.4", E127°28'32.9", alt. 115 m, on *Pinus densiflora* bark, 08 October 2005, L. Lökös 050676 (KoLRI); Haenam Co., Mt. Talmasan, N34°22'52.7", E126°34'40.8", alt. 270 m, on *Pinus densiflora* bark, 26 July 2005, Hur 050331 (KoLRI); Kangwon Prov., Mt. Seorak, N38°09'969", E128°27'831", alt. 673 m, on rock, 24 May 2009, Y. Joshi & X. Y. Wang 090835 (KoLRI).

Remarks — *Lepraria neglecta,* another alectorialic acid containing South Korean species, differs in having a hard, granular thallus with inconspicuous medulla and densely packed soredia, in contrast to the thallus of *L. eburnea,* which is soft with a distinct medulla and loosely packed soredia.

7. *Lepraria jackii* Tønsberg, Sommerfeltia 14: 200, 1992

Diagnostic characters — Thallus leprose, powdery, whitish green to greenish or bluish gray, usually diffuse, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes forming ±rounded colonies which eventually coalesce. Margins diffuse or rarely delimited. Lobes absent. Soredia abundant, dispersed or forming a thick continuous layer, very fine to coarse, 20–40(–130) µm in diam., commonly aggregated in ±round consoredia 80–160 µm diam., projecting hyphae sometimes present, short. Medulla absent. Hypothallus present, sparse to continuous, white. For further descriptions see Tønsberg (1992), Bayerová et al. (2005), Slavíková-Bayerová & Orange (2006), and Elix (2009).

Chemistry — Spot test reactions: thallus K– or + pale yellow, C–, KC–, P–. Secondary metabolites: Atranorin, Zeorin and a fatty acid (jackinic/rangiformic acid).

Ecology — In South Korea, the species is found growing over bark at an altitude of 500 m.

Geographical distribution — Europe, North America, Asia and Australia (Saag et al. 2009); new to South Korea.

Specimen Examined – South Korea: Chungchongbuk Prov.: Mt. Joryong, N37°48'27.0", E128°03'32.0", alt. 500 m, on bark, 10 July 2008, Hur 080314 (KoLRI).

Remarks — *Lepraria jackii* may be confused with two other atranorin and zeorin containing South Korean species: *L. caesiella* and *L. lobata. Lepraria caesiella* differs in lacking jackinic/rangiformic acid and a medulla and/or hypothallus, while *L. lobata* has relatively hard thallus with densely packed soredia and bigger (≤ 300 µm) consoredia.

8. *Lepraria leprolomopsis* Diederich & Sérus., Bibl. Lichenol. 64: 76, 1997

Diagnostic characters — Thallus leprose, powdery to cottony, yellowish green, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes forming ±rounded colonies which eventually coalesce.

Margin delimited. Lobes absent. Soredia abundant, medium sized, 75–110 µm in diam., commonly aggregated in ±round consoredia up to 140–300 µm diam., projecting hyphae sometimes present. Medulla present, white. Hypothallus usually present, poorly developed, white. For further descriptions see Aptroot et al. (1997).

Chemistry — Spot test reactions: thallus usually K+ yellow, C–, KC–, P+ pale orange. Secondary metabolites: Atranorin and Stictic acid complex.

Ecology — At the collection site (285 m), the species was found growing over non-calcareous soil.

Geographical distribution — Australasia (Papua New Guinea) (Saag et al. 2009); new to East Asia (South Korea).

Specimen Examined – South Korea: Chungchongbuk Prov.: Mt. Joryong, N37˚01'33.3" E128˚11'59.2", alt. 285 m, on soil, 28 October 2006, Hur 061111 (KoLRI).

Remarks — *Lepraria leprolomopsis,* which may be confused with *L. lobificans,* another South Korean species containing atranorin and the stictic acid complex, can be diagnosed by its yellowish thallus, medium to coarse (75–110 µm diam.) harder soredia with or without projecting hyphae, and lack of zeorin. *Lepraria lobificans* differs in having greenish thallus, loosely packed fine to medium sized (20–60 µm diam.) soft soredia with long projecting hyphae, and zeorin.

9. *Lepraria leuckertiana* (Zedda) L. Saag., Lichenologist 41: 41, 2009

Diagnostic characters — Thallus leprose, cottony and powdery to granular, whitish gray to bluish gray, diffuse or weakly delimited, forming ±regular rosettes or irregular patches, firmly attached to the substratum. Margins delimited but not forming true lobes, obscure sublobes present. Soredia abundant, fine to coarse, up to 425 µm in diam., not well separated from each other. Medulla present, well developed, white, patches with exposed medulla present. Hypothallus absent. For further descriptions see Zedda (2000).

Chemistry — Spot test reactions: thallus K–, C–, KC–, P–. Secondary metabolites: Usnic acid, Zeorin, Isousnic acid (traces), Triterpenes.

Ecology — At the collection (1222 m), the species was found growing over bark.

Geographical distribution — Widely distributed throughout Central and South America, Australia, southern/southeastern Asia (Singapore, Indonesia, Sri Lanka), and southern Africa (Saag et al. 2009, Elix 2009); new to South Korea.

Specimen Examined – South Korea: Kangwon Prov.: Gitdae bong, N37˚18'367" E128˚56'766", alt. 1222 m, on bark, 15 May 2009, Y. Joshi & X. Y. Wang 0910401 (KoLRI).

Remarks — Other closely similar usnic acid containing South Korean species with which *L. leuckertiana* might be confused are *L. coriensis* and *L. texta*. Distinctly lobed thallus margins with raised rims and presence of constipatic acid diagnose *L. coriensis*, while the lack of medulla and presence of whitish hypothallus distinguishes *L. texta*.

10. *Lepraria lobata* Elix & Kalb, Mycotaxon 94: 220, 2006 ["2005"]

Diagnostic characters — Thallus leprose, granular, bluish gray, margin delimited, forming thin to thick ±continuous extensive irregularly spreading patches. Margins with sublobes 0.2–0.7 mm wide. Soredia sparse to abundant, dispersed or forming a thick continuous layer, fine to coarse, 20–60 µm in diam., aggregated in ±rounded consoredia up to 300 µm diam., projecting hyphae present, long, up to 100 µm long. Medulla present, conspicuous, white. Hypothallus absent. For further descriptions see Elix (2006a).

Chemistry — Spot test reactions: thallus K+ yellow, C–, KC–, P+ pale yellow. Secondary metabolites: Atranorin, Zeorin and a fatty acid (roccellic/angardianic acid).

Ecology — At the collection site (494 m), the species was found growing over bark.

Geographical distribution — Australia (Saag et al. 2009); new to East Asia (South Korea).

Specimen Examined – South Korea: Kangwon Prov.: Baekseok bong, N37˚28'739" E128˚39'760", alt. 494 m, on bark, 16 May 2009, Hur 090456, 090462 (KoLRI).

Remarks — The similar *L. pallida*, another South Korean lepraria containing atranorin and zeorin, can be differentiated from *L. lobata* by its gray to black hypothallus and an unidentified fatty acid. *Lepraria lobata* lacks a hypothallus and has roccellic/angardianic fatty acid.

11. *Lepraria lobificans* Nyl., Flora 56: 196, 1873

Diagnostic characters — Thallus leprose, cottony to rarely powdery, bluish gray to greenish gray, margin diffuse to rarely delimited, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes becoming partly detached from the thallus. Margins sometimes with delimited sublobes 0.5–1.0 mm wide. Soredia abundant, dispersed or forming a thick continuous layer, fine to coarse, 20–60 µm in diam., commonly aggregated in ±round consoredia up to 300 µm diam., projecting hyphae present, long, up to 100 µm long. Medulla present, conspicuous, white. Hypothallus rarely present, scarce, pale brown. For further descriptions see Laundon (1992) and Elix (2009).

Chemistry — Spot test reactions: thallus K–, C–, KC–, P+ pale orange. Secondary metabolites: Atranorin, Zeorin and Stictic acid complex.

Ecology — At the collection site (630 m), the species was found growing on soil over non-calcareous rocks.

Geographical distribution — Cosmopolitan (Saag et al. 2009); new to South Korea.

Specimen Examined – South Korea: Kangwon Prov.: Mt. Hwangbyong, N37°44'41.3" E128°37'31.0", alt. 630 m, on soil over rocks, 14 July 2008, Hur 080352 (KoLRI).

Remarks — *Lepraria leprolomopsis* and *L. caesioalba* var. *caesioalba* are the other atranorin and stictic acid complex containing South Korean species. A yellowish thallus, harder, medium sized to coarse (75–110 μm diam.) soredia with or without short projecting hyphae separates *L. leprolomopsis* from *L. lobificans,* while the absence of medullary hyphae distinguishes *L. caesioalba* var. *caesioalba*.

12. *Lepraria membranacea* (Dicks.) Vain., Acta Soc. Fauna Flora Fennica 49(2): 265, 1921

Diagnostic characters — Thallus crustose to squamulose to subfoliose, leprose, membranous, pale yellow gray to yellow-white, consisting of powdery lobes, forming irregular rosettes. Margins delimited. Lobes present, well developed, up to 2 mm long and wide, with a raised rim. Soredia abundant, sometimes not well separated at margin, fine to coarse, 40–65 μm in diam., commonly aggregated in ±round consoredia up to 130–210 μm diam., projecting hyphae sometimes present, short. Medulla present, conspicuous, white. Hypothallus present, well developed, dark, sometimes white along margins. For further descriptions see Laundon (1989) and Elix (2009).

Chemistry — Spot test reactions: thallus K+ yellow, C–, KC–, P+ reddish orange. Secondary metabolites: Pannaric acid, atranorin (in traces).

Ecology — At the collection site (770 m), the species was found growing over non-calcareous rocks.

Geographical distribution — Cosmopolitan (Saag et al. 2009); new to South Korea.

Specimen Examined – South Korea: Chongchung Prov.: Mt. Gyeryong, N36°21'25.6", E127°12'35.3", alt. 770 m, on rock, 23 October 2004, Hur 041632 (KoLRI).

Remarks — *Lepraria diffusa* and *L. vouauxii* are the other dibenzofuran producing South Korean species with which *L. membranacea* might be confused. However, *L.membranacea* has pannaric acid as its major secondary compound separating it from *L. diffusa* with 4-oxypannaric acid 2-methylester as the only major dibenzofuran and *L. vouauxii* with pannaric acid 6-methylester as the major dibenzofuran.

13. *Lepraria neglecta* (Nyl.) Erichsen, Flechtenflora von Nordwestdeutschland: 394, 1957

Diagnostic characters — Thallus leprose, granular, whitish gray to bluish gray to yellowish gray, margins diffuse or weakly delimited, forming ±regular rosettes or irregular patches, firmly attached to the substratum. True lobes absent, obscure sublobes present. Soredia abundant, coarse, 100–130(–200) µm in diam., commonly aggregated in ±round consoredia up to 200–300 µm diam., projecting hyphae usually absent. Medulla sometimes present, inconspicuous. Hypothallus sometimes present, poorly developed, gray to brown. For further descriptions see Laundon (1992) and Elix (2009).

Chemistry — Spot test reactions: thallus K+ yellow, C– or + orange-red, KC+ orange-red, P+ lemon yellow or orange. Secondary metabolites: Alectorialic acid and a fatty acid (roccellic/angardianic acid).

Ecology — *Lepraria neglecta,* one of the most common *Lepraria* species in South Korea, has been found growing on bark and soil over rocks between elevations of 300–706 m.

Geographical distribution — Widely distributed throughout Europe, North and South America, Asia, Australasia, Antarctica, Greenland (Saag et al. 2009); new to South Korea.

Specimens Examined – South Korea: Jeollanam Prov.: Jangheung Co., Mt. Cheongwan, N34˚32'09.1" E126˚55'32.3", alt. 450 m, on *Pinus densiflora*, 07 October 2005, L. Lökös 050651 (KoLRI); Jeollanam Prov.: Mt. Cheongwan, N34˚32'33.1" E126˚55'46.7", alt. 300 m, on bark, 07 October 2005, Hur 050543 (KoLRI); Jeollanam Prov.: Mt. Cheongwan, N34˚32'33.1" E126˚55'46.7", alt. 300 m, on soil over rock, 07 October 2005, Hur 050545 (KoLRI); Kangwon Prov.: Dongbalam valley, N37˚51'692" E128˚31'522", alt. 706 m, on soil over rock, 23 May 2009, Y. Joshi & X. Y. Wang 090730-2 (KoLRI).

Remarks — *Lepraria eburnea,* another alectorialic acid containing South Korean species, differs in having a soft thallus with a distinct medulla and loosely packed soredia. The thallus of *L. neglecta* is hard and granular with an inconspicuous medulla and densely packed soredia.

14. *Lepraria pallida* Sipman, Herzogia 17: 33, 2004

Diagnostic characters — Thallus leprose, granular to partly membranous, whitish gray to bluish gray, forming ±regular rosettes or irregular patches, loosely attached to the substratum. Margins usually delimited. Lobes present in places, usually well developed (0.5–2.0 mm wide and long) with ±raised marginal rim. Soredia abundant, sometimes not well separated from each other, medium sized up to 100 µm in diam., projecting hyphae absent. Medulla present, white. Hypothallus present, tomentose, gray to black. For further descriptions see Sipman (2004).

Chemistry — Spot test reactions: thallus K+ pale yellow, C–, KC–, P– or pale yellow to yellow-orange. Secondary metabolites: Atranorin and Zeorin in majority, unidentified fatty acids (minor).

Ecology — *Lepraria pallida,* one of the most common *Lepraria* species in South Korea, has been found growing over both bark and non-calcareous rocks between elevations of 410–1265 m.

Geographical distribution — South America and Africa (Saag et al. 2009); new to East Asia (South Korea).

Specimens Examined – South Korea: Jeollanam Prov.: N35°19'09.7" E127°44'31.4", alt. 1265 m, on rocks, 15 November 2006, Hur 060652 (KoLRI); Kyongsangnam Prov.: Mt. Cheontae, N36°09'26.6" E127°36'22.7", alt. 542 m, on rock, 03 November 2006, Hur 061190 (KoLRI); Kyongsangnam Prov.: Mt. Worak, N36°52'55.5" E128°06'35.8", alt. 990 m, on soil over rocks, 19 September 2004, Hur 041235 (KoLRI); Kyongsangnam Prov.: Mt. Gaya, N35°48'11.9" E128°08'35.0", alt. 500 m, on soil over rocks, 05 May 2006, Hur 060090 (KoLRI); Chungchongbuk Prov.: Mt. Songni, N36°32'06.6", E127°50'42.5", alt. 410 m, on *Pinus* bark, 21 April 2006, Hur 0600039 (KoLRI); Kangwon Prov.: Mt. Seorak, N38°09'981" E128°27'267", alt. 463 m, on soil over rocks, 24 May 2009, Y. Joshi & X. Y. Wang 090815 (KoLRI); Kangwon Prov.: Gitdae bong, N37°18'367" E128°56'766", alt. 1222 m, on soil over rocks, 15 May 2009, Y. Joshi & X. Y. Wang 090403 (KoLRI).

Remarks— *Lepraria lobata* is another atranorin, zeorin and fatty acid containing South Korean species with which *L. pallida* is likely to be confused. Lack of hypothallus and presence of roccellic/angardianic acid separate *L. lobata* from *L. pallida,* which always has a gray to black hypothallus and unidentified fatty acids.

15. *Lepraria texta* K. Knudsen, Elix & Lendemer, Lichen Flora of Greater Sonoran Desert Region Vol. 3: 387, 2008

Diagnostic characters — Thallus leprose, powdery, yellow green to greenish gray, forming thin to thick ±continuous extensive irregularly spreading patches, or sometimes forming ±rounded colonies. Margins not delimited. Lobes absent. Soredia abundant, dispersed or forming a thick continuous layer, not well separated from each other, fine, up to 50 µm in diam., projecting hyphae present, short. Medulla absent. Hypothallus sometimes present, conspicuous, white. For further descriptions see Knudsen & Elix (2008).

Chemistry — Spot test reactions: thallus K± yellow, C–, KC–, P–. Secondary metabolites: Usnic acid, Zeorin, Atranorin.

Ecology — At the collection site (1104 m), the species was found growing over non-calcareous rocks.

Geographical distribution — North America (Saag et al. 2009); new to Asia (South Korea).

Specimen Examined – South Korea: Kangwon Prov.: Galjeongok bong, N37˚52'952" E128˚30'161", alt. 1104 m, on rocks, 22 May 2009, Y. Joshi & X. Y. Wang 090583 (KoLRI).

Remarks — *Lepraria texta* might be confused with two other usnic acid containing South Korean species, *L. coriensis* and *L. leuckertiana*. Distinctly lobed thallus margins with raised rims and presence of constipatic acid distinguish *L. coriensis,* and the presence of thick and cottony medulla characterises *L. leuckertiana*.

16. *Lepraria vouauxii* (Hue) R.C. Harris, Bryologist 90: 163, 1987

Diagnostic characters — Thallus leprose, cottony to powdery, yellowish gray, margins diffuse to weakly delimited, forming ±regular rosettes or irregular patches, firmly attached to the substratum. True lobes absent, obscure lobes present, without raised rims. Soredia abundant, coarse, up to 100 µm in diam., aggregated in ±round consoredia up to 300 µm diam. Medulla present, thick, white, often exposed between soredia. Hypothallus present, brownish. For further descriptions see Laundon (1989) and Tønsberg (2004).

Chemistry — Spot test reactions: thallus K+ faint yellow, C–, KC–, P–. Secondary metabolites: Pannaric acid 6-methylester, Atranorin and Zeorin.

Ecology — At the collection site (1192 m), the species was found growing over soil on rocks.

Geographical distribution — Cosmopolitan (Saag et al. 2009); new to South Korea.

Specimen Examined – South Korea: Kangwon Prov.: Dongbalam valley, N37˚51'359", E128˚30'974", alt. 1192 m, on rocks, 23 May 2009, Y. Joshi & X. Y. Wang 090672-1 (KoLRI).

Remarks — *Lepraria vouauxii* is often confused with two other dibenzofuran producing South Korean species, *L. diffusa* and *L. membranacea*. *Lepraria diffusa* has 4-oxypannaric acid 2-methylester as only major dibenzofuran, while *L. membranacea* differs in producing pannaric acid as major substance. *Lepraria vouauxii*, on the other hand, contains large quantities of pannaric acid 6-methylester.

17. *Lepraria xerophila* Tønsberg, Lichen Flora of Greater Sonoran Desert Region Vol. 2: 328, 2004

Diagnostic characters — Thallus crustose to squamulose to subfoliose, membranous, pale yellow-gray to yellow-white, determinate, forming ±irregular patches. Margins delimited, obscurely lobed, lobes up to 2 mm long and wide, with ±raised rim. Soredia few or absent, numerous large granules similar to

isidia are present. Medulla present, conspicuous, white. Hypothallus absent. For further descriptions see Tønsberg (2004).

Chemistry — Spot test reactions: thallus K–, C–, KC–, P–. Secondary metabolites: Norascomatic acid (Chemotype 2). It is the rarest chemotype of this species.

The common chemotype of this species is Chemotype 1, which contains pannaric acid 6-methylester, rangiformic and/or roccellic acid, atranorin, methyl porphyrilate, porphyrilic acid, pannaric acid, and an unknown dibenzofuran (Tønsberg 2004, Elix & Tønsberg 2004).

Ecology — At the collection site (1101 m), the species was found growing over non-calcareous rocks.

Geographical distribution — Europe and North America (Saag et al. 2009); new to Asia (South Korea).

Specimen Examined – South Korea: Kangwon Prov.: Galjeongok bong, N37°52'880", E128°26'849", alt. 1101 m, on rocks, 22 May 2009, Y. Joshi & X. Y. Wang 090637 (KoLRI).

Remarks — So far *Lepraria xerophila* is the only South Korean norascomatic acid containing species and thus easily separated from other Korean species.

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